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LIST OF EXHIBITS

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1.0 EXECUTIVE SUMMARY

1.1 Introduction

The recommendations of this study focus on modifying the Defense Software Repository System (DSRS) reusable asset classification to comply with published guidance (DoD 8020.1-M and TAFIM), support Domain Engineering, establish more effective asset searching, and increase interoperability.

The Enterprise Model is in draft and evolving toward final adoption. The DoD vision of software reuse states that reuse is the preferred alternative for developing and supporting software. The Software Reuse Initiative vision is to guide the DoD software community from its current re-invent the software cycle to a process-driven, domain-specific, architecture-based, repository-assisted way of constructing software.

In this changing environment, the DSRS has the highest potential to become the DoD standard reuse repository because it is the only existing deployed, operational, repository with multiple interoperable locations across DoD. Specifically, in November, 1993, seven DSRS locations support nearly 1,000 users and list nearly 9,000 reusable assets. The DISA DSRS alone lists 3,880 reusable assets and has 400 user accounts. DSRS is adaptable to additional types of reusable assets and better methods of describing them. The description of repository assets is called classification.

This reports the results and recommendations of a study of classification methods for storage and retrieval of Reusable Assets (RAs) in the DSRS. The recommendations of this study focus on modifying the Defense Software Repository System (DSRS) reusable asset classification to achieve policy compliance, support Domain Engineering, establish more effective asset searching, and increase interoperability. The study reviews and analyzes interrelationships between the classification approaches, asset evaluation, certification, storage, and retrieval techniques of available classification methods. The study recommends changes to DSRS classification.

The far-term strategy of the DoD Software Reuse Initiative supports a virtual repository. These interconnected repositories will provide the ability to locate and share reusable components across domains and among the services. Thus, an effective and evolving DSRS is a central requirement to the success of the DoD software reuse initiative. Evolving DoD repository requirements demand that DISA continue to have an operational DSRS site to support testing in an actual repository operation and to support DoD users.

The classification process for the DSRS is a basic technology for providing customer support. This process is the first step in making reusable assets available for implementing the functional and technical migration strategies. DSRS users:

- Identify which reusable assets stored in the DSRS, and associated repositories, might be of use in their current projects.
- Obtain summary information on the identified assets.
- Retrieve assets that can be reused on the user's project.

1.2 Conclusions

DSRS can be enhanced to support the needs of its users by implementing a number of near-term, mid-term, and far-term enhancements. The recommendations focus on modifying the asset classification to support Domain Engineering and searching tailored to individual needs.

1.2.1 Improve DSRS Classification and Retrieval

The DSRS classification method is sound and should be enhanced to improve support for the DoD Software Reuse Initiative.

Asset classification should be modified to comply with DoD 8020.1-M soon. Compliance will be improved by adding a primary domain term. Since asset distribution limits are a concern, a term 'distribution limit' should also be added. In the future, better compliance with policy and standards will require refined domain terms, domain certification, and improved storage of graphical models.

Users are not concerned with classification details. The retrieval process should be modified to simplify the user's search for assets.

The initial classification and asset description for storage in the repository should be captured by the development process.

Many domain engineering products are graphical. Users would benefit from the implementation of a graphical user interface which can display model-based views of domain models and architectures.

1.2.2 Improve Related Processes

Near-term recommendations emphasize simplifying the use of the DSRS for novice or infrequent users. Providing users with pocket guides, augmenting system help facilities with computer-assisted tutorials, and holding and publicizing DSRS training sessions for targeted users. These materials should be provided on-line in the DSRS as soon as possible.

In the mid-term, we believe that as consensus is achieved on the domain engineering process and products across DoD, the DSRS should be further enhanced to support domain engineering.

Far-term improvements to the DSRS can be achieved by simplifying the user's view of the repository. Also, a Graphical User Interface should be used to improve and simplify user access to DSRS classification and assets.

1.3 Summary of Methodology

The study involved (1) a review of applicable government documents, (2) interviews with users — classifiers, domain engineers, and software engineers, (3) activities by study personnel as surrogate users of the DSRS, and (4) a review of the classification methodologies and operation of other repositories.

Study personnel conducted phone interviews with DSRS classifiers, domain engineers, and software engineers. Interviewers compiled ideas concerning improvements to the classification scheme, relative priority of requested improvements, and ease of use of the DSRS. The study analyzes information obtained from the DISA Software Reuse staff, from users, and from research conducted by the team.

2.0 CURRENT CLASSIFICATION METHOD BACKGROUND

The current DSRS methodology specifies asset characteristics by "facet" and by term within "facet". Users have given the approach mixed reviews. Appendix C contains the interview guidelines and results of the interviews, and section 3 contains an analysis of the current DSRS classification method. The method was originally developed to provide a computer science view of source code assets. However, an expanded mission, like that of the DSRS, which includes diverse products from multiple domains, needs an improved classification method. The current DSRS classification method:

- Uses terms.
- Contains terms within the broader range of the "facet".
- Needs to be expanded to include DoD enterprise model view of information systems.
- Needs improvement in user convenience.
- Is labor intensive and contributes to inconsistent classification by classifiers.
- Contains some inconsistencies in terms and inadequate definitions.

2.1 Standing Issues

A number of issues were identified by DISA reuse center personnel. These issues guided the content of the interview guides, the analytical effort, and the criteria for prioritizing the recommendations. The standing issues were:

- Classification method should reflect domain engineering vocabulary and products and a wider range of assets than software artifacts. Classification method should be able to address all software life cycle artifacts and other reusable assets including training materials.
- Classification method should be transparent to users and well understood by classifiers.
- Classification changes should encompass all reusable assets and domain engineered products.
- Classification method should interface easily with the software life cycle process and products.
- Classification changes should be retrofitted to existing inventory promptly.

2.2 Objectives

The objectives of the study were:

- Determine improvements to DSRS classification based upon DoD domain engineering guidance, analysis of DSRS functionality, consultation with users, and examination of other reuse repositories and libraries.
- Create a phased action plan identifying the events required to achieve those improvements.
- Consider the potential for automation of reusable asset classification as part of DSRS evolution.

2.3 Assumptions

The study was conducted with the following assumptions:

- Changes to the classification method will be phased.
- The intent is to address domain engineering and simplify use of the repository.
- Near-term recommendations will retain the existing classification method emphasizing a more domain-oriented, top-down view. These also will include attempts to influence user behavior through changes to on-line help, preparation of pocket guides, and

creation of a new course to provide typical search scenarios and review of pocket guides for domain engineers and software engineers.

- Mid-term and far-term recommendations will evolve the classification method and its supporting software.

2.4 Scope

The scope of the study, analysis, recommendations, and action plan are the system requirements definition, system design, and prototyping and testing, via creation and testing of scenarios instead of software, of the following aspects of the system:

- Classification and retrieval of assets
- Support for domain engineering
- Improvements to user convenience.

An understanding of how the functional design of the recommendations to the DSRS classification method will affect ongoing efforts in the above three aspects of the system has also been gained.

In addition to the Executive Summary and the Current Classification Method Background sections, this report includes Conclusions and Recommendations and an Evolution Action Plan. The conclusions and recommendations were derived from analysis of interviews with DSRS users, guidance from reuse center personnel, and research conducted by the study team. Detail of the study is in the Detail Report separately provided.

3.0 CONCLUSIONS AND RECOMMENDATIONS

The Enterprise Model is in draft and evolving toward final adoption. The DoD vision of software reuse states that reuse is the preferred alternative for developing and supporting software. This study found that the current DSRS provides a solid foundation of reuse repository capabilities which support the DoD Software Reuse Initiative. Several improvements could provide users with more effective access to the available assets as well as support architecture-based, domain-specific, reuse of a wider range of Reusable Assets (RAs).

The current implementation of the DSRS is a significant improvement toward repository-assisted software development. Adding support for domains defined in DoD guidance will increase its effectiveness and better support domain engineering products included in the repository.

3.1 Summary of Recommendations

Recommendations are organized into near-term, mid-term, and long-term recommendations. The recommendations focus on modifying asset classification to support Domain Engineering and searching tailored to individual needs.

3.1.1 Near-Term Recommendations

The DSRS reuse infrastructure was established before domain engineering activities began and enterprise integration policy was developed. Approval and implementation of near-term recommendations will enable the reuse infrastructure to support implementation of enterprise integration policy

through classification, storage, and retrieval of domain engineering reusable assets.

Near-Term Recommendations

Recommendations	Objectives
Modify asset classification	- Comply with Enterprise Integration policy (8020.1-M) - Support domain engineering strategic plan - Add domain term - Add ownership term - Group terms to support domains
Develop a user pocket guide (On-line and hard-copy)	- Outline search techniques and system access

Exhibit 3-1

3.1.2 Mid-Term Recommendations

Mid-term recommendations build on the near-term improvements to evolve asset classification and repository use to improve user service and adhere to enterprise integration policy.

Mid-Term Recommendations

Recommendations	Objectives
Evolve asset classification	- Adhere to policy - Improve definitions and descriptions - Develop domain certification levels
Simplify classification and retrieval methods	- Consider regrouping terms - Reduce users knowledge of classification method - Improve consistency - Reduce labor costs of classification method - Improve consistency - Reduce effort
Analyze metrics	- Support evolution decisions
Educate classification users	- Improve access to reusable assets - Improve use by classifiers

Exhibit 3-2

3.1.3 Far-Term Recommendations

Far-term recommendations continue to expand upon earlier enhancements.

Far-Term Recommendations

Recommendations	Objectives
Improve domain engineering support	- Improve policy compliance - Refine domain terms - Improve storage of products (multimedia)
Improve user interface	- Make classification transparent to users
Evolve interoperable classifications	- Develop common description - Reduce effort

Exhibit 3-3

3.2 Recommendations Discussion and Rationale

The time-phased recommendations guide the evolution of the DSRS classification and associated infrastructure to support the role envisioned for reuse repositories in the DoD enterprise integration policy. This evolution provides the continuous user services necessary to support the migration strategies and target system development. Today's users will benefit from an easier to use system and future domain-oriented users will have the repository capabilities needed to perform architecture-based, domain-specific, repository-assisted reuse.

3.2.1 Near-Term Recommendations Discussion and Rationale

This section provides discussions of the near-term recommendations and their rationale. The detailed discussion of recommendations is presented in appendix A of the detailed report.

Modify Asset Classification

Taken in its entirety, this recommendation meets the objectives of:

- Comply with Enterprise Integration Policy (DoD 8020.1-M)
- Address domain engineering
- Add primary domain term
- Add ownership term
- Group terms to support domains.

Develop a User Pocket Guide

This recommendation has the objective of improving user services and achieve DoD enterprise policy compliance through enhanced classification method.

A user pocket guide contains helpful notes for searching the DSRS. This pocket guide will assist in a more satisfied, effective, and efficient user by increasing the understanding of retrieval methods. It will reduce search time considerably since the user will have outlined shortcuts for general use. This pocket guide should be available in hard copy form and on-line. This pocket guide should contain the following types of information:

- Steps to perform searches
- Steps to extract assets
- Login procedures
- Phone numbers to call for assistance.

3.2.2 Mid-Term Recommendations Discussion and Rationale

This section provides discussions of the mid-term recommendations and the rationale. The detailed discussion of recommendations is presented in appendix A of the detailed report.

Evolve Asset Classification

The objectives of this recommendation are:

- Group terms to support domain engineering
- Develop domain certification levels
- Improve adherence to policy
- Improve definitions of descriptors.

Analyze Metrics

The objective of this recommendation is to base DSRS evolution decisions on data.

Gather and analyze metrics to determine future classification enhancements and improve the user interface. These metrics should provide data to improve terms, add terms, and other data to maintain and modify the classification method and user interface. These metrics will be collected at all DSRS locations.

Educate Classifiers and Users

The objectives of this recommendation are to improve classifiers use and understanding of procedures and standards, which should make searching easier for users.

3.2.3 Far-Term Recommendations Discussion and Rationale

This section provides discussions of the far-term recommendations and the rationale. The detailed discussion to recommendations is presented in appendix A of the detailed report.

Improve Domain Engineering Support

The objectives of this recommendation are to:

- Improve policy compliance
- Refine domain terms
- Improve product storage to include graphics.

Evolve Interoperable Classifications

The objectives of this recommendation are to progress toward common descriptions, in order to achieve the vision of the virtual repository concept. Reuse repositories need to agree on common descriptions of reusable assets, and move toward central management through the development of uniform procedures adopted standards and cooperation of efforts eliminating duplication.

Make Classification Transparent

The user interface should be improved to simplify or reduce visibility of the classification method. This can be achieved by implementing search capabilities which do not require detailed user knowledge of the classification method.

4.0 DSRS CLASSIFICATION METHOD EVOLUTION ACTION PLAN

Enhancing the current classification method is the best means to improve the repository. The recommendations and objectives discussed in section 3 are the guidelines for the evolution of the DSRS. This is an evolution action plan for implementing near-term, mid-term, and far-term recommendations.

4.1 DSRS Evolution Introduction

The evolution action plan supports the DoD software reuse vision to improve the quality and reliability of software intensive systems and shorten development and maintenance time by providing for enhancements to the DSRS that allow for growth and movement towards a process driven, domain-specific, architecture-based, repository-assisted way of software construction. Supporting DoD enterprise policy and evolving DSRS are vital to improving DoD software reuse effectiveness.

Near-term is defined as zero to six months with no software modifications to the DSRS required. Mid-term is defined as seven to 18 months with consideration given to software modification. The far-term is defined as 19 months and beyond and will allow for the modification of DSRS software. The actions performed to evolve the DSRS are not necessarily sequential in nature, but certain activities do need to be accomplished before other activities begin.

Near-term evolution of the repository will allow compliance to DoD enterprise integration policy, address domain engineering, and assist DSRS users. The near-term will concentrate on enhancing the current classification methodology. Activities will include the addition of terms for primary domain, high demand and distribution restrictions. Terms will be grouped hierarchically, on paper in the near-term, to better support the DoD enterprise model. As domain engineering develops, DSRS will comply. The development of a DSRS user pocket guide will provide hints on searching the DSRS and steps for extracting assets.

Mid-term evolution will continue adherence to DoD policy, improve classification, and develop metrics to identify DSRS future enhancements. The mid-term will build upon changes from the near-term to simplify classification and increase the level of domain support. Activities will include improving the term definitions, adding domain certification procedures and terms, and instituting a controlled vocabulary. It is during the mid-term that the center will begin to assess and improve the existing terms. Metrics on usage characteristics such as high demand components, terms used most often, and asset retrieval will be developed.

Far-term evolution will improve support for domain engineering, provide for enhancements to the user interface that will make the retrieval of assets transparent to the users of the DSRS, and provide further interoperability with other repositories. The far-term will fully support domain engineered products and the center will build upon work already completed to achieve expanded interoperability with other repositories to attain a virtual repository. Enhancements to the user interface will be initiated that will

allow for multiple query mechanisms to the DSRS. This matrix approach to search and retrieval of assets will increase user flexibility and overall ease of use. During the far-term, consideration will be given to the development of a graphical user interface that will assist with the storage, retrieval, viewing of graphical products such as domain models.

Activities need to be initiated to evolve DSRS capabilities. This action plan identifies the activities and milestones required to conduct the phased step-by-step evolution of the DSRS.

4.2 Near-Term Evolution Activities

Near-term DSRS evolution activities' goals are to achieve DoD enterprise policy compliance through enhancement of the classification method and to assist users with searching.

Near-Term DSRS Evolution Activities

Recommendations	Activities	Milestones
Modify Asset Classification	Determine Requirements for the Following Classification Modifications: - Add Domain Terms - Add Horizontal Domain Terms - Add High Demand Terms - Add Distribution Limit Terms	Asset Classification Modification Requirements Definition Document Plan Implementation Implement
	Analyze Terms for Grouping (Bottom-up and Top Down)	Grouped-Term Report
	Support Domain Engineering	Domain Engineering
Develop a User Pocket Guide	Determine Requirements for a Pocket Guide: - Collect User Requirements - Develop Layout of the User Pocket Guide - Produce User Pocket Guide	User Pocket Guide

Exhibit 4-1

4.3 Mid-Term Evolution Activities

Mid-term DSRS evolution activities' goals are to simplify user searching and to develop metrics for future evolution of the DSRS.

Mid-Term DSRS Evolution Activities

Recommendations	Activities	Milestones
Evolve Asset Classification	Determine Requirements for the Following Modifications to Evolve the Classification: - Increase Length of Terms - Increase Length of Definitions	Define Evolve Asset Classification Requirements Plan Implementation Implement

Recommendations	Activities	Milestones
	Improve Definitions and Descriptions	Define Terms
	Determine Requirements for Domain Certification Methodology	Define Certification Levels and Methodology
Simplify Use of Classification	Continue to Analyze Term Grouping (Bottom-up and Top-down)	Group-Term Report
	Implement Controlled Vocabulary	Domain Controlled Vocabulary Report Implement Controlled Vocabulary
	Assess and Improve Terms	Term Assessment Report Implement
	Determine Requirements and Design the Implementation of Grouped Terms in the Database in accordance with DoD 8020.1-M	Database Group-Terms Requirements Definition Document Plan Implementation Implement
Analyze Metrics	Determine Requirements for Metrics: - Design Metrics - Develop Metrics - Implement Metrics	Analyze Metrics Define Enhancement Requirements Plan Implementation Implement
	Analyze Metrics	Compile DSRS Usage Statistics Report
Educate Classification Users	Determine Procedures for Systematic Updating of On-line News	Formulate Procedures for On-line News
	Systematically Update News	Update News

Exhibit 4-2

4.4Far-Term Evolution Activities

Far-term DSRS evolution activities' goals are to improve the storage of domain products, make the retrieval method transparent to the users, and reduce the efforts of achieving interoperability.

Far-Term DSRS Evolution Activities

Recommendations	Activities	Milestones

Improve Domain Engineering Support	Determine Enhancement Requirements for Improving Support of Domain Engineering
	- Design Domain Support Solution
	- Develop the Domain Support Solution
	- Implement the Domain Support Solution
	  - Multi-Media Storage
	  - Storage of Multiple Views
		Identify Domain Engineering Enhancements
		
		Define Requirements
		
		Formulate Solution
		
		Plan Implementation
		
		Implement

Improve User Interface	Determine Enhancement Requirements for Improving the User Interface
	- Design the User Interface Solution
	- Develop the User Interface Solution
	- Implement the User Interface Solution
	  - Modified Storage and Retrieval Method
	  - Simplified Retrieval Method
		Define User Interface Requirements
		
		Design Solution
		
		Plan Implementation
		
		Implement

Evolve Interoperable Classifications	Build on Existing Interoperability with CARDS and ASSET and Determine Additional Requirements for Interoperability	Analyze Interoperability Issues and Alternatives
	Dedicate a Resource to Concentrate on Interoperability Issues	Identify Resource Dedicate Resource

	Determine Requirements for the Development of Automated Support Tools
	- Design Automated Tools
	- Develop the Automated Tools for Classification
	  - Automate Prompting of Classification Terms
	  - Automate Navigation through Defined Hierarchies
	- Implement the Automated Tools
		Define Requirements
		
		Plan Implementation
		
		Implement

Exhibit 4-3

4.5DSRS Evolution Summary

The evolution action plan for the DSRS classification method provides a high level description of the activities and milestones required for the DSRS to support the concept of software reuse, domain engineering, and user interfaces. The DSRS is significantly more advanced than many of the other repositories evaluated. The DSRS contains the largest number of assets, has a flexible and adaptable classification methodology and is moving forward with interoperability to achieve the vision of the DoD reuse initiative.

The near-term activities presented in the action plan can be completed with little disruption. Adding domain terms and high demand terms supports the enterprise model and begins a phased approach to supporting domain engineered products and services. Adding a pocket guide will improve the user's access efficiency and capability.

The mid-term enhancements build upon earlier steps. Certification levels for domain engineering products will be developed to provide users with quality and completeness information. Further enhancements are planned for the classification and retrieval methods making searching easier for the user, through longer terms and expanded definitions.

The far-term enhancements to the DSRS will require a higher degree of change. The user interface will be expanded to make the retrieval method transparent to the user, and DSRS interoperability will be expanded. Full capabilities to support domain-engineered products and graphics will be designed to improve policy compliance.

In summary, the CIM initiative states that the vision of reuse is streamlined systems and reduced effort for developing and maintaining systems. The DSRS will improve its inventory of assets to assist with achieving this vision. A phased approach to enhancing the DSRS is required to support the objectives of DoD domain-specific reuse, interconnected repositories, and architecture-based DoD reuse.

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